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Abstract

The robust and optimal design of carbon/glass fibre-reinforced epoxy hybrid composite laminates under the constraint of a specified minimum flexural strength was investigated in this study. Two conflicting objectives, minimizing material cost and weight, were considered with the design variables being fibre type, fibre orientation angle and fibre volume fraction of the laminas. Three sources of uncertainties, namely, fibre misalignment, lamina thickness variation and the presence of matrix voids were incorporated into the model. This multi-objective robust optimization problem was solved by combining a modified version of the non-dominated sorting genetic algorithm (NSGA-II) with a simple genetic algorithm (GA) as an anti-optimizer. Pareto optimal and robust solutions were found for different levels of minimum flexural strength and the significance of each uncertainty source on the optimal cost and weight of the optimal designs were investigated by conducting analysis of variance (ANOVA) tests. The results indicated that, in general, all three uncertainties affected the cost and weight of the optimal designs with the effect of voids being more critical for void contents of greater than 2%.

Keywords: Polymer matrix composite; Hybrid; Flexural; Multi-objective optimisation; Robustness; Matrix void